YANGON UNIVERSITY OF ECONOMICS
DEPARTMENT OF APPLIED ECONOMICS
MASTER OF PUBLIC ADMINISTRSTION PROGRAMME

A STUDY ON WATER SCARCITY IN HLAING THAR YAR TOWNSHIP, YANGON REGION

MG KAUNG MYAT ZAW

MARCH, 2023

YANGON UNIVERSITY OF ECONOMICS
DEPARTMENT OF APPLIED ECONOMICS
MASTER OF PUBLIC ADMINISTRATION PROGRAMME

A STUDY ON WATER SCARCITY IN HLAING THAR YAR TOWNSHIP, YANGON REGION

A thesis submitted in partial fulfillment of the requirements for the Master of Public Administration (MPA) Degree

Supervised by:

Daw Aye Thanda
Lecturer
Department of Applied Economics

Submitted by:

Kaung Myat Zaw
Roll No. 14
MPA 20th Batch
(2019-2022)

March, 2023

YANGON UNIVERSITY OF ECONOMICS
DEPARTMENT OF APPLIED ECONOMICS
MASTER OF PUBLIC ADMINISTRATION PROGRAMME

This is to certify that this research paper entitled "**A Study on Water Scarcity in Hlaing Tha Ya Township, Yangon Region"** submitted as a partial fulfillment towards the requirement for the degree of Master of Public Administration has been accepted by Board of Examiners.

BOARD OF EXAMINERS

1. Dr. Khin Thida Nyein
   Pro-Rector
   Yangon University of Economics (Chairperson)

2. Dr. Su Su Myat
   Program Director and Head of Department
   Department of Applied Economics
   Yangon University of Economics (Examiner)

3. Daw N Khun Ja Ra
   Associate Professor
   Department of Applied Economics
   Yangon University of Economics (Examiner)

4. U Khun Maung Gyi
   Associate Professor
   Department of Applied Economics
   Yangon University of Economics (Examiner)

5. Daw Aye Thanda
   Lecturer
   Department of Applied Economics (Supervisor)

March, 2023

ABSTRACT

The study focuses on the study of water scarcity in Hlaing Thar Ya Township in Myanmar. It was conducted in Yae Oak Kan village tract and Ward (20) in the Hlaing Thar Ya Township. It is used the descriptive method with quantitative and qualitative approaches in this study. The research found that the more increase in utilization of water, the more access drinking water and more challenges to access it. Not only change the practices of people and knowledge of household about safe drinking water but also the cost about the consumption expenditure of for the drinking water. This study points that the knowledge of water treatment for water scarcity and the way forward for sustainable drinking water distribution system surrounding the industrial zone of the Myanmar.

ACKNOWLEDGEMENTS

I would like to express my special acknowledgements to Professor Dr. Tin Tin Htwe, Rector of Yangon University of Economics for her authorization and kindly giving me the chance to accept this study.

My special thanks to Professor Dr. Khin Thida Nyein, Pro-Rector of Yangon University of Economics, for her excellent guideline and teaching, coaching during my studies.

I would also like to express my sincere appreciation and gratitude to Dr. Su Su Myat, Program Director and Head of Department of Applied Economics, Yangon University of Economics, for their professional guidance, valuable comments, suggestions and encouragements to improve the quality of this thesis. My sincere appreciation is also extended to my supervisor, Daw Aye Thanda (Lecturer, Naypyitaw State Academy) for invaluable support and constant encouragement. I am greatly indebted to all my faculty members for their constructive comments, and affectionate guidance, which have inspired me throughout the time of my study.

I wish to express words of appreciation and acknowledge my sincere gratitude to U Htoot Min (Emergency Officer, United Nations Children's Fund) for his invaluable support, constructive suggestions and continuous encouragement. I am indebted to Ko Naing Moe Thu, for their kind supports and encouragement for my research. I would like to take this opportunity to express my sincere thanks and gratitude to the staff of General Administration Department, Yangon City Development Committee Office in Hlaing Thar Ya, Yangon Region.

I wish to express words of appreciation to WASH Officer and their staff for valuable information, support and help during the survey period. My great appreciation wants to include Team Leader, Community Mobilizer for their hospitality during the data collection period. I acknowledge my gratitude to the water user group of Yae Oak Kan village and Ward (20) who patiently answered my questionnaire and quiz tests. My special thanks are especially extended to the field volunteers for helping me collecting data.

Finally, my appreciation and wholehearted thanks are due to all my friends at MPA for their encouragement, valuable assistance and moral support during my study at MPA.

TABLE OF CONTENTS

		Page
ABSTRACT		**i**
ACKNOWLEDGEMENTS		**ii**
TABLE OF CONTENTS		**iii**
LIST OF TABLES		**v**
LIST OF FIGURES		**vi**
ABBREVIATIONS		**vii**
CHAPTER I.	**INTRODUCTION**	**1**
1.1	Rationale of the study	1
1.2	Objectives of the study	4
1.3	Method of study	4
1.4	Scope and limitations of the study	4
1.5	Organization of the Study	4
CHAPTER II.	**LITERATURE REVIEW**	**5**
2.1	The Earth's Water and the Population	5
2.2	Water Availability Imbalances	6
2.3	Human Uses of Water	6
2.4	Types of Water Scarcity Indicator	7
2.5	Global Problems of Water Scarcity	10
2.6	Factors Associated with Water Scarcity	11
2.7	Health Implications of Water Scarcity	12
2.8	Clean Water and Sanitation	14
CHAPTER III.	**THE UTILIZATION OF WATER IN HLAING THAR YAR TOWNSHIP**	
3.1	Regional profile of Hlaing Thar Ya Township	15
3.2	Informal Settlement and Water Scarcity in Myanmar	18
3.3	The National Strategy for Rural Water Supply	20
3.4	Challenges for Water Supply	22

3.5 Policy issues and Principles of water supply 23
3.6 Water Scarcity in Hlaing Tha Ya 25

CHAPTER IV. SURVEY ANALYSIS

4.1 Survey Design 29
4.2 Survey Finding 30

CHAPTER V. CONCLUSION

5.1 Suggestion 39
5.2 Recommendation 40

REFERENCES

LIST OF TABLES

Table	Title	Page
3.1	Water Supply Targets in Myanmar	21
3.2	Different Types of Drinking Water Services in Myanmar	24

LIST OF FIGURES

Figure	Title	Page
3.1	Climate and Weather by Month	17
4.1	Sources of Drinking Water to Household	30
4.2	Drinking Water Resources in the Study Area	31
4.3	Household Drinking Water Sources	31
4.4	Challenge to access Drinking Water	32
4.5	Money sent on drinking water per month	33
4.6	Time duration (Minute) to reach the drinking source of water	33
4.7	Percentage of respondent about clean and safe drinking water	34
4.7	Percentage Knowledge of water treatment	34

ABBREVIATIONS

CBO	Community Based Organization
GAD	General Administration Department
ID	Irrigation Department
IP	Implementing Partner
MOAI	Ministry of Agriculture and Irrigation
MOHS	Ministry of Health and Sports
MOPF	Ministry of Planning and Finance
NGO	Non-Government Organization
SLRD	Settlement and Land Record Department
UNICEF	United Nations Children's Fund
VWC	Village Water Committee
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization
WSP	Water Safety Plan
WRUD	Water Resources Utilization Department
WUG	Water User Group
WWT	Wastewater treatment

CHAPTER I
INTRODUCTION

1.1 Rationale of the Study

Access to safe drinking water is not only essential for human life but also an internationally recognized basic human right. The use of contaminated water can be damaging to people's health and is among the leading causes for the transmission of diseases such as diarrhea, cholera and dysentery, contributing to undernutrition and long-term health consequences. Unsafe water is responsible for an estimated 842,000 of the deaths caused by diarrhea worldwide annually. Availability and accessibility of sufficient safe water are essential to protect people from water-borne diseases.

Access to safe drinking water is a priority for the government. In SDG No.6 "Ensure availability and sustainable management of water and sanitation for all" which address six targets as per below. There are achieve universal and equitable access to safe and affordable drinking water for all, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.

Reducing for water scarcity, target as substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering. Continuously, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate and protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

Regarding for implementation, to expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies. Then, they need to support and strengthen the participation of local communities in improving water and sanitation management. There is a range of household-level drinking water services including the one from safely managed drinking water as "safe drinking water".

Measurement of Myanmar households' access to safe drinking water has been

undertaken on a large scale for the first time in the 2019 Intercensal Survey. Prior to this 2019 survey, access to safe drinking water was measured only through small-scale studies. Drinking water services are defined according to accessibility, availability and quality of households' main drinking water source. The resulting scale describes a range of household-level drinking water services – services which are safe, basic or limited refer to the use of improved water sources, whereas services with unimproved and surface sources are the least safe options.

The Population and Housing Census (2014) measured households' use of drinking water from improved, unimproved and surface sources at the township and village tract/ward levels in Myanmar for the first time. The Myanmar Demographic and Health Survey (2015 - 16) and the Myanmar Living Conditions Survey (2017) reviewed these same indicators at the state/region level, in addition to measuring households' access to limited and basic drinking water services. The Intercensal Survey (2019) measures all these indicators at the state/region and district levels in addition to testing for the presence of a common fiscal contaminant (E. coli) as a measure of the safety of households' drinking water. This is the first time this aspect of drinking water safety has been measured at the national scale in Myanmar, though it does not measure chemical contamination. This was, at the time of publication, the largest known national survey to measure the presence/absence of E. coli, covering 19,077 households. In its use of an inexpensive, easy-to-use test at such a large scale, this approach provides a model for future water quality monitoring surveys.

In 2019, 82% of households countrywide were using drinking water from improved sources, and 12% used surface water (rivers, lakes, ponds, etc.), with significant differences between urban and rural areas. Rural households in Myanmar were more likely to use surface water (16% in rural areas compared to 4% in urban areas), with lower use of drinking water from improved sources (78% in rural areas and 92% in urban areas). Water access, infrastructure and quality control are the main impediments to rural areas' access to safe and affordable water supply services.

This marks an improvement since 2014 when approximately 73% of households were using drinking water from improved sources. At the township level, half of Myanmar's townships had over 80% of households using drinking water from improved sources. Most of these townships were concentrated around the Ayeyarwady River. An additional 95 (30%) townships had fairly high levels of use of drinking water from improved sources (60-79% of households). The areas with

the lowest use of drinking water from improved sources are found mainly in the coastal areas of Rakhine, Ayeyarwady, Yangon and Bago. These townships tend to be highly reliant on surface water which has a greater risk of contamination. In Kayan township in Yangon Region for example, 99% of households use surface water as their main source of drinking water. Conversely, the majority of townships in Chin State had high levels of drinking water from improved sources, though its safety is uncertain as piped water can come from unsafe water sources (Changing Sources of Drinking Water in Myanmar (2014-2019).

The families of residents, dormitory, squatter and migrant factory workers in industrial zone of Hlaing Thar Yar Township in Yangon Region focus around increasing access to clean water, improving sanitation including environmental hygiene and menstrual hygiene management, and improving access to safe at their workplaces.

The private donors and agencies have been implementing the emergency supply of drinking water to poor and marginalized households of Hlaing Thar Yar Township since July 2021 to address the dire needs for supply of safe drinking water, and provided much needed support to alleviate any public health issues that may arise from the consumption of poor-quality drinking water, particularly during this time of pandemic. The distribution of safely managed drinking water continues while long-term durable and sustainable solutions are underway. In the industrial zone area of Hlaing Tha Yar, wastewater and chemicals from the factories are increasingly discharged into the ditches and rivers unsystematically. It can lead to degradation and pollution of water, air and soil. As well as the government can't provide enough water supplies for the whole area and the villagers have to use the impurity water consist of various chemicals. They can't afford to buy clean water all the time, except for their drinking. So, the villagers have suffered from the infectious diseases, causing loss of income or high expenditure for health.

1.2 Objectives of the Study

The main objective is to analyse the drinking water scarcity of the community in residents, dormitory and squatter in Hlaing Thar Yar Township.

1.3 Method of Study

The method used in this paper is mainly the descriptive method of research employing both the primary data and secondary data. The secondary data sources based on information from relevant institutions, publications, reports, new letters and various internet websites.

1.4 Scope and limitations of the Study

This study emphasis the utilization of drinking water and its scarcity effect. But it does not cover the whole of the country because there are different demographic factors of the region. It focuses on villages and wards of Hlaing Thar Yar in which include Yae Oak Kan Village and Ward 20.

1.5 Organization of the Study

This paper consists of five chapters. Chapter I is the introduction and literature review on overview water scarcity is included in Chapter II. Furthermore, the utilization of water in Hlaing Thar Ya Township and the outcomes from survey analysis show in the Chapter III and IV. Finally, in Chapter V, conclusion and recommendation for better improvement included.

Chapter II

Overview of Water Scarcity

Population growth, economic development, and nutriment shift have resulted in increasing water demand, and consequently pressures on water resources. Most of the place of the world are existing water scarcity, which generally refers to the condition wherein demand for water by all sectors, including the environment, cannot be satisfied fully due to the impact of water use on supply or quality of water (Falkenmark et al., 1989; Alcamo et al., 2000; Vörösmarty et al., 2000). Water supply crisis was described as the important high-impact risk for our current times in the Global Risks 2015 Report of the World Economic Forum. “Addressing water scarcity and quality” is one of the six themes of the Eighth Phase of the International Hydrological Programme (IHP-VIII) that focuses on water security: responses to local, regional and global challenges (2014–2021).

2.1 The Earth’s Water and the Population

The fresh water may be the most unforgiving among the world’s renewable resources. Water is the essential item for food production, to economic development and for living standard development because it is difficult to purify, expensive to transport from one place to another and cannot possible to substitute it. Water is important for human health and well-being of the population of the country. Therefore, the improvement of water quality is one of the first priorities for technology transfers from wealthy countries to poorer ones in the conference of the United Nation’s new Commission on Sustainable Development.

Although more than two thirds of the world’s surface is covered by water, the renewable fresh water is an increasingly scarce commodity. There is no more essential fresh water on the world when the earth’s human population was less than 3% its current size of near 6 billion people in 2000 years ago. The finite nature of renewable fresh water makes as a critical natural resource to examine in the relation of population growth. Due to the population growth of the world, the average amount of renewable fresh water available to each person declines. Moreover, changes in global weather could reduce water supplies. It is one of the challenges of managing water supply.

Therefore, acute water shortages should require the extra ordinary measures in the most countries.

2.2 Water Availability Imbalances

Although water remains abundant in many countries, the availability and quality of the renewable water resources is insufficient in other countries due to the unsustainable uses of water. This is especially true in Africa and the Middle East but over time the ratio of people to renewable water supply is likely to become a concern in parts of Asia and Latin America and possibly even in Europe. The essential limits are not at the global level but at regional, national and local levels. In measuring a country's water resources, there are two types of resources - endogenous, or internal and exogenous or external resources. Internal water supply is the amount falls on national region minus that portion lost through evaporation. External water supply flows into a country from rivers and water level originating in other countries and is vulnerable to the restrictions of those countries. The world's fresh water reserves were more than adequate to serve human needs while maintaining the integrity and biological diversity of the earth's ecosystems throughout most of human history. As the population of the country have grown, the fresh water has become increasingly less available where and when it is needed. Some developing countries can currently mobilize only 20% of their potential water resources.

2.3 Human Uses of Water

The agricultural sector is the largest drain on water supplies in the worldwide. The second largest percent of water withdrawal is the demand of industry and energy and the others is the use of domestic or households. The pattern of use varies from country to country, depending on the of the water use levels of economic development, climate and the population size. In Africa, 88% of the water use in the agricultural sector especially for irrigation while the high-income countries such as Europeans is used the water for their industries and the hydroelectric energy production. The domestic water use including drinking, food preparation, washing, cleaning, gardens and service industries such as restaurants and laundromats that accounts for only a small portion of total use in most countries. The amount of water people applies to households' purposes tends to increase with rising standard of living and variations in domestic water use are substantial. In the United States, each individual uses more than 700 liters each day for

domestic tasks but the average individual uses are 29 liters to meet the households needs. Therefore, the amount of use in water is depend on the country that are rich or poor which have fewer agriculture or industry sector in that country.

The industries include the energy production, the use water for cooling, processing, cleaning and removing industrial wastes of the industry. Nuclear and fossil-fueled power plants are the largest industry users by applying the amounts of water for cooling process. The water is used for the water cycle in some industries. It is often contaminated by chemicals and heavy metals or its temperature is increased to the determinants of the water ecosystems. Industrial use varies from less than 5% of withdrawals in dozens of developing countries to as much as 85%. Only in Europe where depend on the irrigation is relatively low, the amount uses in the industrial water equal the sum of water applied in agriculture and domestic uses. The proportion of water used for industrial purposes is seen as an indicator of the economic development.

2.4 Types of Water Scarcity Indicators

There are some indicators of the water scarcity such as:

i. The Falkenmark Indicator
ii. Water Use to Availability Ratio
iii. Physical and Economic Water Scarcity—The IWMI Indicator.
iv. Water Poverty Index

2.4.1 The Falkenmark Indicator

The Falkenmark indicator (Falkenmark et al., 1989), measuring water scarcity is a simple yet widely used method for calculating water scarcity. It requires: the number of people living within a given spatial domain and the volume of water (termed blue water by Falkenmark) available within that domain. The volume of water available per person is then calculated in m3/cap/year. The indicator's reliance on population leads to the Water Crowding Index (WCI), which measures the number of people per unit of available water, e.g., persons/million m3/year. A value of 1,700 m3/cap/year of renewable freshwater was proposed as the threshold for water scarcity (Falkenmark et al., 1989], below which social stress and a high level of competition for water emerges [Falkenmark and Rockström, 2004). If water availability falls below 1,000 m3/cap/year, then the area experiences high water scarcity, and below 500 m3/cap/year, absolute scarcity. However, its ease of application is tempered by an important caveat: the index is only an indication of supply side effects on global water scarcity (Schewe

et al., 2014). The indicator overlooks temporal variability and the important drivers of demand, related to economic growth, lifestyle, and technological developments (Savenije, 2000). Management practices and infrastructure are not considered by the index and the simple threshold does not reflect the true spatial distribution of demand within and between the domains over which the index is calculated.

2.4.2 Water Use to Availability Ratio

The water uses to availability ratio, or criticality ratio, is another widely used indicator to assess water scarcity. The advantage of this ratio is that it measures the amount of water used, and relates it to the available renewable water resources (Alcamo and Henrichs, 2002). Over the past decades, the development of water use models has been fast, and water availability and use can now be modeled spatially explicitly on global scale with high spatial resolutions (Alcamo et al., 2003a; Hanasaki et al., 2008; Flörke et al., 2013; Wada et al., 2014). Water use can refer to either water consumption or water withdrawals. Water consumption measures the amount that is removed from rivers, lakes, or groundwater sources and evaporated to the atmosphere. Water withdrawal refers to the amount of water that is withdrawn from these sources, of which part returns to the system by leakage or return flows. The majority of the existing water scarcity studies use withdrawal to indicate water use (Alcamo et al., 2003b; Oki and Kanae, 2006; Wada et al., 2011). Recent work by Munia et al. 2016 uses consumption and withdrawals as a minimum and maximum levels of scarcity, respectively. However, since consumption is normally much smaller than withdrawal, the ratio of consumption to average available renewable water resources usually indicates an unrealistically low level of water scarcity. Based on the water criticality ratio, high water stress occurs if water withdrawal exceeds 40% of the available water resources (Alcamo and Henrichs, 2002). However, as part of the withdrawal water returns back to water bodies and the actual proportion of the return flow vary across regions depending on natural and social-economic and technical conditions, using 40% as a water scarcity threshold may not be consistent in reflecting the status of water scarcity across regions.

2.4.3 Physical and Economic Water Scarcity—The IWMI Indicator

The International Water Management Institute (IWMI) developed a more complex indicator for assessing water scarcity (Seckler et al., 1998), combining the physical and economic water scarcities. Indicator takes into account the proportion of water supply, of a country in question, from renewable freshwater resource available for human requirements, while accounting for existing water infrastructure such as desalinization plants and water stored in reservoirs. A novel element of the index is that it considers an individual country's potential to develop water infrastructure and to improve irrigational water use efficiency. Their analysis yielded five country groupings. The country groupings were in turn used to define whether countries are either "physically water scarce" or "economically water scarce" (Rijsberman, 2006). The former is where countries are unable to meet estimated water demand in 2025, even after accounting for national adaptive capacity. The latter is where countries have a sufficient renewable water resource but would have to invest significantly in water infrastructure to make the resources available for consumption in 2025. The index is available as a Microsoft Excel model (Seckler et al., 1998 yet it has not been used as much as other indicators to assess global water scarcity, with exception to an assessment conducted by Cosgrove and Rijsberman (2000). One reason for this is that it is considerably more complex than many other indices reviewed here and thus more time-consuming to compute. Another is perhaps that its interpretation is less intuitive than other indices and therefore less attractive for presentation to the public and/or a policy audience (Rijsberman, 2006).

2.4.4 Water Poverty Index

The Water Poverty Index (WPI) proposes a relationship between the physical extent of water availability, its ease of abstraction, and the level of community welfare (Sullivan, 2001). It considers five factors: resources or water availability; access to water for human use; effectiveness of people's ability to manage water; water use for different purposes; environmental integrity related to water and of ecosystem goods and services from aquatic habitats in the area. The WPI is mainly designed for assessing the situation facing poor water endowments and poor adaptive capacity. The WPI is calculated with the weighted average of the five components, each of which is first standardized so that it falls in the range 0–100; thus, the resulting WPI value is also between 0 and 100, representing the lowest and the highest level of water poverty (Sullivan et al., 2003). The indicator has the advantage of comprehensiveness.

However, its application is hampered by its complexity and lack of information for some of the factors required for building the indicator on large scale (Rijsberman, 2006). It has so far only been applied at the community level for pilot sites in a few countries.

2.5 Global Problems of Water Scarcity

Clean and fresh water is not a privilege but it is a necessity. Although water covers a large portion of our planet, most of that water isn't fit for human consumption. According to the World Wildlife Federation, only three percent of all earth's water comes from freshwater sources. Most significantly, approximately two-thirds of clean water is inaccessible. The majority of freshwater is located inside the polar ice caps and glaciers. Without interventions from organizations, water scarcity can undermine human health. Over the next five to ten years, water scarcity could affect as much as two-thirds of the population adversely.

Everyone to have more than standard access to water and the water needs to be safe for all. Untreated water puts countless people at risk, especially children, the elderly, and those with pre-existing health conditions. Currently, there is not a one-size-fits-all solution to the water scarcity crisis. Design teams, engineers, and more work together to create healthy solutions for entire communities. System designs permit the safe and effective removal of bacteria, viruses, chemicals, and other harmful substances from water sources. The following problems are about why scarcity is a global problem.

1. High childhood mortality rates linked to clean water scarcity
2. Basic sanitation affects 21% of the world's population
3. An estimated 50% of child malnutrition linked to unsafe water
4. Water and sanitation fuels productivity
5. Deaths occur annually due to unsafe water
6. Half of the population will live in water scarce areas
7. Females in low-income Countries spend hours by collecting water
8. Approximately 80% of wastewater flows back into the ecosystem
9. Each person needs a minimum of 20-50 liters of water per day

2.5 Factors Associated with Water Scarcity

Myanmar is the abundant water resources but largely unused. In spite of the abundant water resources, government at all levels (federal, state and local) have not

been able to successfully control these resources to ensure a sustainable and equitable access to safe, adequate, improved and affordable water supply and sanitation to its population. Myanmar has begun deal with issues of water scarcity across a number of its states – forcing infrastructure and long-term sustainability questions. Increasing population, rising demands for food and cash crops, increasing urbanization and rising standards of living are the major factors leading to shortage in supply of fresh waters. Water scarcity is one of the main problems to be faced by many societies and the world in the 21st century. Water use has been growing at more than twice the rate of population increases in the last century, and, although there is no global water scarcity as such, an increasing number of regions are chronically short of water (UNDESA,2011).

Water scarcity is both a natural and a human-made phenomenon. There is enough freshwater on the planet for six billion people but it is distributed unevenly and too much of it is wasted, polluted and unsustainably managed. According to Ki-moon (2011) United Nation Secretary General, shortages of water contribute to poverty. They cause social hardship and impede development. They create tensioning conflict-prone regions. Where we need water, we find guns. There is enough water for all of us but only so long as we keep it clean, uses it more wisely, and shares it fairly. Rapid population growth has not been accompanied by an increase in the delivery of essential urban services such as water supply, sewage and sanitation, and collection and disposal of solid wastes, it is estimated that currently only about 50% of the urban and 20% of the semi-urban population have access to reliable water supply of acceptable quality (i.e. something better than a traditional source). Overall effective urban water supply coverage may be as low as 30% of the total population due to poor maintenance and unreliability of supplies. Rural coverage is estimated at 35% (FGN,2000).

No urban community has a sewage system, with the result that sewage and spillage either lie stagnant or are disposed through the storm water drainage system. The proportion of the population with access to safe facilities for disposal of excreta and waste water is low than for water supply. However, there are still many health problems in rural areas due to polluted drinking water and a shortage of water for daily hygiene. Rural areas face specific problems not encountered in the towns. It is simply too expensive to provide a house-to-house water supply because homes are so widely scattered. Many rural people have low incomes and find it difficult to fund or maintain a water supply. They also lack the skills needed to maintain the water source. Water schemes therefore need to be simple to operate, and cheap to construct and maintain.

Villagers need spare parts, tools and materials if these schemes are to be successful in the long run (DFID, 2003).

One of the fundamental problems affecting millions of Myanmar is lack of access to safe sources of water supply and adequate means of disposal of human waste, refuse and drainage facilities. This is compounded by lack of adequate awareness of proper hygiene and sanitary behaviors that result in water and sanitation related diseases (Ochekpe,2011). The main challenges and constraints to adequate supply of safe drinking water include: Lack of appropriate policy, legal, regulatory and institutional framework. High population growth which results in an ever-increasing demand for water and sanitation services against a diminishing trend in supply thereby creating a large supply gap. Low investment level in operation and maintenance which accounts for frequent break down of distribution facilities.

The failure of water schemes in the past is attributable to the non – involvement of the intended beneficiaries, either at the point of initiation/conception of the schemes or in their funding, execution and monitoring, among others. Failure to appreciate that water is a finite resource and an economic and environmental good for which realistic tariff should be charged to recover at least operational and maintenance costs. Inadequate public awareness about water conservation and management for effective sanitation and public health hygiene. Poor community participation in water supply and sanitation matters, creating the impression that sanitation is government business. Ever increasing rate of urbanization resulting in shortages of water supply and sanitation services in urban and semi urban area.

2.6 Health Implications of Water Scarcity

Malaria is the predominant disease affecting the population of Myanmar. Many other diseases endemic throughout the country is generally associated with unsatisfactory drinking water supply, poor sanitation conditions and inadequate health education programs. These include diarrhea, dysentery, gastro – enteritis, infectious hepatitis, hook work, guinea worm, scabies and other parasitic infections. The prevalence HIV/AIDs are currently about 5% and probably increasing. Health implications of water supply deficiencies in Myanmar are enormous. As the percentage of people with access to safe water in the country is low and the country is relatively densely populated, the direct health repercussion the situation imposes, especially on children, is often underestimated (FGN,2000).

Water supply is an input in many industries. As water is usually considered as an infrastructure service which is final consumption product targeted to meet the basic needs of households. The cost of water supply deficiencies in public policy is often overlooked, underestimated, or totally unaccounted for. The heavy incidence of water supply failures among small firms has an implication for the growth of firms, industries, and the generation of employment (FGN,2000).

The health consequences of water scarcity include diarrhea diseases such as cholera, typhoid fever, salmonellosis, other gastrointestinal viruses, and dysentery. Water scarcity and poor sanitation have remained daunting challenges for concerned citizens and development partners, despite the endowed resources at the disposal of the most populated black nation. The ripples effects of the country's weak health sanitation also have direct impact on the nation's workforce as many people in the working class and children lose thousands of men – hours to communicable diseases. Many families have stories to tell about pains suffered from loss of children, especially less than five years (Akintola,2011). Uwejamomere (2011) acting country representative of Water Aid Nigeria, lamented the scourge among children, He noted that 11 percent of all under five deaths occur in Nigeria, based on UNICEF record. Children continue to suffer disproportionately from diarrhea diseases, with more than 2 million children under age 5 dying every year from diarrhea and pneumonia related illnesses. The simple act of washing hands with soap at critical moments, such as after using toilet and before handling food, remains a key cost – effective and life –saving intervention in preventing these diseases and deaths (Akintola.2011).

2.7 Clean Water and Sanitation

Water scarcity affects more than 40 percent of people, an alarming figure that is projected to rise as temperatures do. Although 2.1 billion people have improved water sanitation since 1990, dwindling drinking water supplies are affecting every continent.

More and more countries are experiencing water stress, and increasing drought and desertification is already worsening these trends. By 2050, it is projected that at least one in four people will suffer recurring water shortages.

Safe and affordable drinking water for all by 2030 requires we invest in adequate infrastructure, provide sanitation facilities, and encourage hygiene. Protecting and restoring water-related ecosystems is essential.

Ensuring universal safe and affordable drinking water involves reaching over 800 million people who lack basic services and improving accessibility and safety of services for over two billion.

In 2015, 4.5 billion people lacked safely managed sanitation services (with adequately disposed or treated excreta) and 2.3 billion lacked even basic sanitations.

Goal Targets

- By 2030, achieve universal and equitable access to safe and affordable drinking water for all
- By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations
- By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally
- By 2030, substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity
- By 2030, implement integrated water resources management at all levels, including through transboundary cooperation as appropriate
- By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes
- By 2030, expand international cooperation and capacity-building support to developing countries in water- and sanitation-related activities and programmes, including water harvesting, desalination, water efficiency, wastewater treatment, recycling and reuse technologies
- Support and strengthen the participation of local communities in improving water and sanitation management

CHAPTER III

THE UTILIZATION OF WATER IN HLAING THAR YAR

The current study emphasizes the Hlaing Thar Yar Township in western part of Yangon and will concentrate around industrial zone especially Hlaing Thar Yar Township.

3.1 Regional Profile of Hlaing Thar Yar Township

Hlaing Thar Yar Township is located in the western part of Yangon, Myanmar. It is one of the biggest townships in the country and it is also the most populated township. It comprises 20 wards and nine village tracts and shares borders with Htantabin Township in the north and west, Insein Township, Mayangon Township, and Hlaing Township in the east (across the Yangon River), and Twante Township in the south. The township is connected to other parts of Yangon across the Yangon river over the Aung Zeya Bridge and the Bayinnaung Bridge, and to Twante township over the Pan Hlaing river by the Pan Hlaing Bridge.

Hlaing Tha Yar is the most developed of the new satellite towns founded in the 1980s. Hlaing Thar Yar Township has an area of 26.01 sq miles and it is an administrative area of Northern Yangon Division. In the late 1980s, the township became an industrial zone, and since 1993, it has been developed to a residential area as part of city expansion, mainly for housing squatters, who were resettled from the inner city by the government. Industrial zones have been established in Hlaing Thar Ya Township since 1995. Now, the total number of factories is 588 in industrial zones. The industrial zones had been carried out by the Management Committee, which was formed on 24.7.1996 and maintenance fees are collected Ks.10000 for per acre / month from local investors and USD 50 for per acre/month from foreign investors.

Hlaing Tha Yar Industrial Zone, consisted of mostly garment and other light industries, is one of the largest industrial parks in the country. Showpiece gated communities of the wealthy like the FMI City and Pun Hlaing Garden Residences in the southeastern part of the township are the domain of the country's elite and are arguably among the best communities in the country.

The total area of land is (1401.98) acres and (1087.98) acres has been used as the Industrial area. There are (588) operating factories in this Industrial Zone. There are different types of factories such as Garment, Food-Stuff, Toiletry, Construction Materials, Electrical Goods, Forest Products, Chemical Products, Press-related, Machinery Parts, Cold Storage, Grain and General.

3.1.1 Population of the Study Area

In 2019, the total population of Hlaing Thar Yar Township is 440949, people that 211287 are males and 229662 are females. It has 57770 households and 80701 families. There are 427827 Myanmar nationals and 100 foreigners in this township. Myanmar nationals living in the township are Kachin, Kayah, Kayin, Chin, Bamar, Rakhaine, Shan and other nationals. Majority of people in the township are Bamar with 427827 people making up the 97.02% of the total population of the township, the second largest nationals are other races, 13122 people making up the 2.97% of the total population of the township, the third largest number of people is Kayin, 6035 people making up the 1.36% of the total population of the township. There are 19 Chinese 0.14% of the total numbers of foreigners living in the township: 99 Indians are 0.75% of the total number of foreigners living in the township. 2 Pakistanis are 0.015% of the total number of foreigners living in the township; Among them, there are 422529 Buddhists, 95.82% of the total population of the township; 3700 Islam 0.83% of the total population of the township; 6410 Christians with 1.45% of the total population of the township; and 8230 Hindus with 1.86% of the total population of the township. (Township Profile of GAD (2019))

3.1.2 Climate of the Study Area

Hlaing Thar Yar has a tropical climate. In winter, there is much less rainfall in Hlaing Thar Yar than in summer. The Köppen-Geiger climate classification is Aw. The average annual temperature in Hlaing Thar Yar is 26.8 °C | 80.2 °F. The annual rainfall is 2276 mm | 89.6 inch. This region, situated near the equator line, is characterized by difficult-to-define summer seasons. The best time to visit is January, February, September, October, November, December.

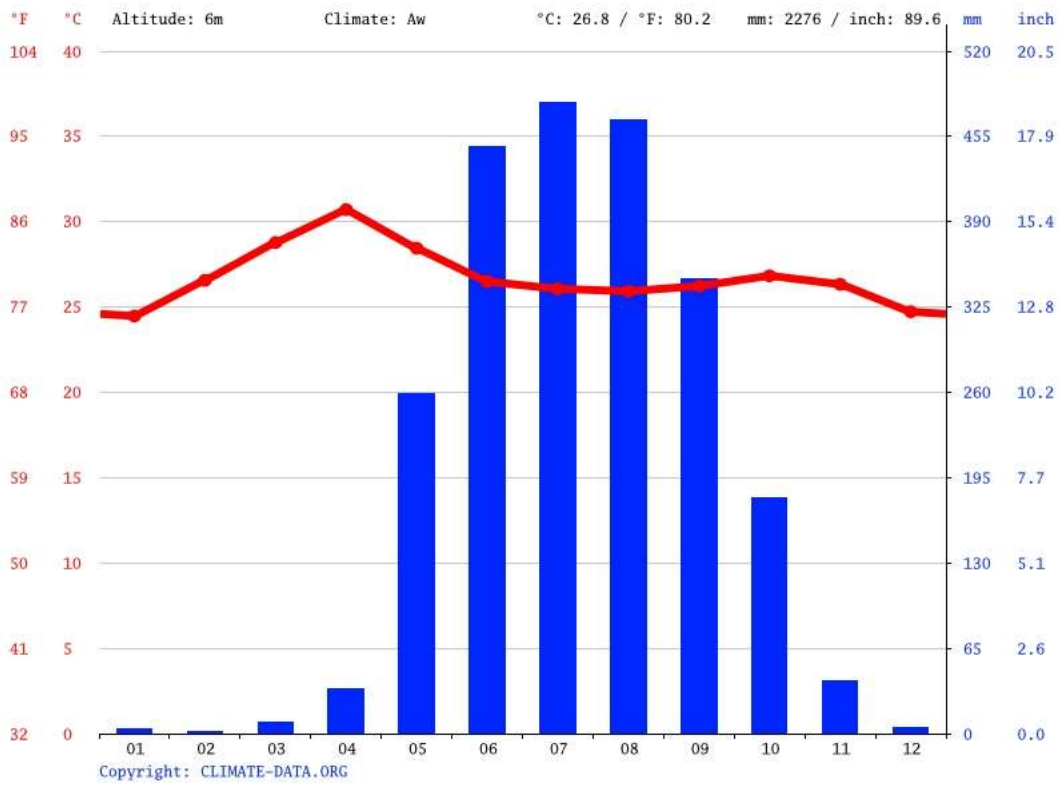
The driest month is February, with 2 mm | 0.1 inches of rainfall. With an average of 481 mm | 18.9 inch, the most precipitation falls in July. The warmest month of the year is April, with an average temperature of 30.7 °C | 87.3 °F. January has the lowest

average temperature of the year. It is 24.5 °C | 76.0 °F. The difference in precipitation between the driest month and the wettest month is 479 mm | 19 inches. During the year, the average temperatures vary by 6.2 °C | 11.2 °F.

The month with the highest relative humidity is August (90.39 %). The month with the lowest relative humidity is February (51.97 %). The month with the highest number of rainy days is August (28.90 days). The month with the lowest number of rainy days is February (0.37 days).

In Hlaing Thar Yar, the month with the most daily hours of sunshine is March with an average of 10.35 hours of sunshine. In total there are 320.95 hours of sunshine throughout March. The month with the fewest daily hours of sunshine in Hlaing Thar Yar is January with an average of 7.13 hours of sunshine a day. In total there are 214.02 hours of sunshine in January. Around 3134.17 hours of sunshine are counted in Hlaing Thar Yar throughout the year. On average there are 103.17 hours of sunshine per month.

Figure (3.1) Climate and Weather by Month in Hlaing Tha Yar Township



Source:https://en.climate-data.org/asia/myanmar/yangon/hlaing-thar-yar-54396/#climate-graph

The climate of Myanmar varies depending on location and in the highlands, on elevation. The climate is subtropical/tropical and has three seasons, a "cool winter" from November to February, a "hot summer" season in March and April and a rainy season from May to October, dominated by the southwest "monsoon". A large portion of the country lies between the Tropic of Cancer and the Equator and the entirety of the country lies in the monsoon region of Asia, with its coastal regions receiving over 5,000 mm (196.9 in) of rain annually. Annual rainfall in the delta region is approximately 2,500 mm (98.4 in), while average annual rainfall in the central dry zone is less than 1,000 mm (39.4 in). The higher elevations of the highlands are predisposed to heavy snowfall, especially in the North. The Northern regions of Myanmar are the coolest, with average temperatures of 21 °C (70 °F). Coastal and delta regions have an average maximum temperature of 32 °C (89.6 °F).

3.2 Informal Settlement and Water Scarcity in Myanmar

Myanmar is poised to rapidly urbanize in the coming years, with the proportion of the population living in cities expected to double from approximately 13% today to around 25% by 2030. The rapid growth in urban populations to date – primarily in Yangon and Mandalay – coupled with a prolonged under provision of housing – has led to the growth of a number of informal settlements. Despite the fact that informal sector plays a major role in city functions and contributes to the economy making the city competitive and vibrant, the unregulated nature of the informal sector can create major problems for the wider city and individuals living in informal settlements. These informal settlements are undocumented, have no connections to municipal infrastructure or basic services, and lack any kind of security of tenure. Furthermore, there is little knowledge or data on the extent of, location, or living conditions of these settlements. In this context, the identification of informal settlements becomes a necessary step to improving living conditions which can lead to official recognition, security of tenure, and the provision of basic services and infrastructure to the informal settlements. The informal settlements have been classified into seven typologies, based on preliminary research and additional observations during ground verification, for the purpose of this study:

1. ***Roadside settlement:*** Settlements where houses are built along roadsides, at a typical depth of one street.

2. ***River/Creekside settlement:*** Settlements where houses are built on unoccupied (often flood-prone) land along rivers and creeks.
3. ***Peri-urban land settlements:*** Settlements where houses are built on agricultural land that have been subdivided without authorization and where plots are rented, sold, or leased for residential purposes; these settlements have been absorbed into the municipal boundary as the city expands.
4. ***Resettlement area subdivisions:*** Unauthorized subdivisions on resettlement sites from the 1980s and 1990s, typically with minimal infrastructure including drainage, in which have resulted in a high-density settlement with small, overcrowded houses.
5. ***Village tract subdivisions:*** Settlements where houses are built on land that is categorized as rural but has recently been incorporated into the authority of an urban area local government. In these settlements, plots are often illegally subdivided, and are characterized by overcrowding and poor or non-existent infrastructure.
6. ***Inner-urban infill:*** Small, often opportunistic settlements built on or adjacent to developed areas, and are characterized by clustering around areas of employment generation such as building sites or factories.
7. ***Slum settlements:*** Settlements that are built on illegally occupied public or private land such as vacant land, park land, or under-developed sites.

3.2.1 Informal Settlement in Hlaing Thar Yar

Today, Hlaing Thar Yar Township is one of the biggest and most populated townships in the country. This is the result of several resettlement programs initiated by the Myanmar government. A first phase of resettlement to Hlaing Thar Yar (HTY) took place between 1985 and 1988, when the government allocated over 3,600 plots for the fire victims from Sein Pan Myine ward of Mayangone Township. Then, from 1988 to 1989, the government resettled over 25,000 squatter households to Hlaing Thar Yar. Simultaneously, the township developed into an industrial zone and since 1993, it became part of city expansion. After cyclone Nargis in 2008, the township experienced a sudden increase in population due to an influx of internally displaced persons. Today, Hlaing Thar Yar has the highest number of informal settlements, in total 181, with approximately 24,865 households and a population size of 124,325.

These settlements cover a land area of 1,822.31 acres or 7.37 square kilometers, approximately 1.23 % of the city's total land area and house an estimated 365,000 people or between 6-8% of the city's total population. The location of the informal settlements in Yangon, according to the classifications described in the preceding section. The distribution of the number of informal settlements, the total land area of the settlements, and their total population by township for the city of Yangon. The largest numbers of informal settlements are located in the township of Hlang Thar Yar, which has 181 or 43% of all informal settlements in the city. These 181 settlements cover an area of approximately 500 acres and house 34% of all informal residents.

The majority has been living on their plot of land for 5 to 10 years (37%), 1 to 3 years (18%), 3 to 5 years (17%), less than a year (16%) and almost every 10th household has been living in the area for more than 10 years (12%). No major differences can be identified when looking at the six specific types of settlements, where a large proportion settled between 5 to 10 years ago. This finding can be explained by the aftermath of cyclone Nargis, that hit Myanmar in 2008 and destroyed large parts of the south west of the country, especially Ayeyarwady. In the wake of cyclone Nargis, many people migrated in search of better livelihood opportunities and income.

In different types of settlement locations, the households living along river/creek banks are diverse with most coming from Ayeyarwady (42%), followed by elsewhere in Yangon (30%), but notably also from the same ward (10%) or same township (10%) and 8% came from various other places.

3.3 The National Strategy for Water Supply

The purpose of national strategy is to set out the way to meet the needs of the rural populations for improved domestic water supply services, access to and use of improved sanitation with elimination of open defecation, and improved hygiene behavior by the Year 2030, the target date for achievement of the Sustainable Development Goals. It also addresses water, sanitation and hygiene in schools up to high school level and health facilities up to township hospital level. All organizations working in or supporting the WASH Sector - Government, Development Partners, International NGOs, national and local NGOs, and private sector - shall work in accordance with the Strategy and its approach, principles, goal, strategic objectives, standards and guidelines. Departments in three Ministries have cooperated in the development of the Strategy and Investment Plans:

- Department of Rural Development
- Department of Basic Education
- Department of Public Health, with support and input from other relevant departments.

The Departments worked together in a Task Force chaired by DRD. The strategic goal of water supply is that all the rural populace will have access to effective, efficient and affordable services for improved water supply by 2030. There are water resource management, water supply design, planning and infrastructure, water quality standards and water safety plans and Operation and maintenance.

The Strategy is for the period from 2016 to 2030. The first three years, from January 2016 to December 2018 will be a transition period to move from the current approach to the approaches and ways of working defined in the Strategy. It is intended that the Institutional Arrangements should be completed by then. An implementation/action plan is to be developed for the institutional changes and other early actions required during the transitional period. The National Strategy of water supply targeted as for three components as follows;

- Rural water supply
- School water supply
- Rural health center water supply.

Table (3.1) Water Supply Targets in Myanmar

	2015	2020	2025	2030
Rural community supply				
• Access to portable water supplies and improved water for other domestic uses	61	70	85	100
School supply				
• Improved water supply		40	65	100
Rural health center				
• Improved water supply		50	75	100

Source: The National Strategy for water supply, sanitation and hygiene

3.4 Challenges for Water Supply

The change in approach to service delivery and development of private sector for water supply and sanitation marketing. Ensuring sustainability by addressing a number of legal, institutional, financial, social, technical and environmental challenges. Improving coordination of sector stakeholders at and between all levels of service delivery and management. Clearly defining the roles and responsibilities in the water supply sector of Government Departments at all tiers of government. Organizational capacity at all levels needs to be assessed and developed. Development of the capacity of the small-scale private sector to meet the needs of developing and running services, in particular for sanitation and operating small water supply systems. To improve understanding of gender in water supply, in order to enable women, as the main users with responsibility for domestic water and for household sanitation, to become decision-makers on domestic water supply and sanitation and for men to accept their decisions. To understand and address the special needs of people with disabilities to access and use services. Monitoring and management information systems for collecting, managing and using data are very weak.

The development of services to reach the 2030 targets is seriously underfunded - generating capital funding from Government allocations, development partners and other sources will require focused advocacy. Adequate funding of the operational costs is essential to ensure sustained performance of the services. A particular challenge is affordability for service users in the context of high levels of poverty. The challenge is to develop and provide services and facilities that all sections of the community can pay for, so that they can be sustained. Despite the relatively high coverage of improved water supply and improved sanitation, there are high levels of water and sanitation related diseases and growth stunting of children under 5. Behavior change programmes need to be improved to address this. Technical factors include the need to develop affordable options for sanitation for the poorer and poorest households; and sanitation options in difficult areas. There is no system for managing or controlling solid waste in rural areas. On environmental factors, management of water resources is weak, and there is very little control of major polluters of water, such as mining, industry and agriculture. Climate change is a growing threat to the sustainability water resources.

3.5 Policy issues and Principles of Water Supply

Policy issues and principles that are established through this Strategy. Sustainability of improved water supply and sanitation facilities and hygiene behaviors is a key objective of service delivery. Accurate and reliable data is an essential for local management of WASH development and service operation. For this integrated data collection and management system from the lowest operational level up union level needs to be created and maintained.

(i) Water resource management

Planning, development and management of water resources need to be governed by a common integrated perspective considering local, regional, state and national contexts, having an environmentally sound basis, keeping in view the human, social and economic needs.

(ii) Cost sharing for water supply

Communities should contribute a part of the capital cost of community water supplies, 100% of the operation and maintenance costs and a part of the cost of the advisory maintenance support service run by Townships.

(iii) Integration of water supply, sanitation and hygiene promotion

Development of services should integrate the water supply, sanitation, including solid waste management, and hygiene promotion components together.

(iv) Operation and maintenance

User communities are responsible for operation and maintenance of the water supply service, through a representative Village Water Committee, supported by a township level O&M advisory support service. The VWC should have adequate representation of both women and men, ethnic minorities and other vulnerable groups.

(v) Decentralization of service provision and management

The provision and management of water supply and sanitation services and hygiene promotion in rural areas should conform to the Government's policy of decentralization.

(vi) Accountability and transparency

All organizations have multiple accountabilities - downwards to electorates, beneficiaries, students and patients, partners and staff, and upwards to higher levels of Government, and donors.

3.5.3 Water Supply and Improved Sanitation Situation in Myanmar

The most comprehensive and detailed data set for available for estimating access to improved water supply and improved sanitation is the National Census of 2014. The below shows the access to water supply and sanitation in rural areas and access data for States and Regions. This data needs to be treated with some caution, however. For water supply, the responses are self-reported in answer to the census question at the time, so may not count existing water supply systems that were not working at the time.

Scale of Drinking Water Services

Drinking Water services are defined according to accessibility, availability and quality of household's man drinking water source. The scale of result describes a range of household-level drinking water services in which are safe, basic or limited refer to the use of improved water sources, whereas with improved and surface sources are the least safe. The different types of drinking water sources are used to determine drinking water services. The different types of drinking water sources that households use are piped, tube well, protected dug well, rain, bottled, unprotected well, tanker and surface water.

Table (3.2) Different Types of Drinking Water Services in Myanmar

Improved Low Contamination Risk	Safe Managed 	Drinking water from an improved source which is located inside the user's dwelling, plot or yard, available when needed and free of fecal and priority chemical contamination as arsenic or fluoride. Only fecal coliforms test.
	Basic (≤30 minutes) 	Drinking water from an improved source and collection time is not more than 30 minutes for a roundtrip including queuing.
	Limited 	Drinking water from an improved source and collection time is over 30 minutes for a round trip including queuing.
Unimproved High Contamination	Unimproved 	Drinking water from unprotected dug wells or unprotected springs or any other source where water is not protected from the outside.

	Surface 	Drinking water from a river, dam, lake, pond, steam, canal or irrigation channel or diches.

Source: Changing Sources of Drinking Water in Myanmar (2014 – 2019)

Water supply services in the resettlement areas are serviced by Yangon Municipality's basic infrastructure and services, although given the overwhelmingly poor condition of all resettlement areas visited and low level of service city-wide, it seems likely that the vast majority of houses in resettlement areas do not have access to piped water or sanitation, and are likely to have poor drainage. The water supply coverage by Yangon City Development Committee (YCDC) is about 38% and people with no water supply service obtain water from other water sources, like wells, tube wells, ponds, and rain in Yangon (JICA and YCDC, 2013). There were 825,620 households in Yangon City, however, the number of water connections, households connected with city water supply system, was only 269,268 at the end of 2013. Based on the number connection, the water demand coverage of Yangon city was about 32 % (Aung, 2014). The water supply coverage for North Okkalapa, South Okkalapa, North Dagon, and Thaketa in 2012 was 24%, 25%, 18% and 14% respectively (YCDC, 2014). However, water supply coverage for Hlaing Thar Yar and Shwe Pyi Thar is much lower than other town ships in Yangon. The water supply coverage for Hlaing Thar Ya and Shwe Pyi Thar in 2011 was about 2% and 7% respectively. The situation has not much improved since 2011. In Hlaing Thar Yar 69% people get water from Private wells, followed by 23% from neighboring wells.

3.6 Water Scarcity in Hlaing Thar Yar

In this area, the villagers cannot get sustainable access to safe clean water is a major problem in the study area in Hlaing Thar Yar Industrial Zone. Hence, the waste water disposed by the factories is an important factor for the region to consider when they suffer from the diseases. In this area, the residents have to use the four sources of water such as Lake-Water, Shallow Tube-well Water (90 feet, Deep Tube-well Water (about 400 feet).

Yay Oakkan Village Group is situated beside Yangon-Pathein Highway, between Hlaing Thar Ya Industrial Zone (3) and (4) in the North of Pan Hlaing River. The area of this village is (1.64685) square miles. The two villages: Thaung Gyi Lay village and Yay Oakkan village consist of this village group. The total population is

(41759) people and there are (4410) households and (2829) houses(Emergency Water Distribution in Hlaing Tha Yar). Their main occupations are factory workers, vendors, trishaw drivers, manuals and small retailer shops. Most of the people are low-income group and according to the villagers' income level although it is divided into four main sources of using water, the pipe-line water, the shallow tube-well water, the deep tube-well water and the coverless lake water. Most of the people have to use the tube-well water because water supply supported by the government is not enough for all villagers. Moreover, the two-third of the population who is low-income group, can't use the pipe-line water sufficiently because of it is more expensive than the tube-well water and the cost of this water has been increasing year by year. So, those people have to use mainly the shallow tube-well water for their water sources.

Before 1997, the water source of this village, a tube well of 90 feet depth is not suitable for the human health because of its geographical situation and this water naturally contains iron, calcium and salinity. So, they have to rely on not only tube-well water but also other water sources for their livelihood. Before 1997, there were about (2000) people in this village and they could also get the water from two natural lakes. The water from these two lakes could provide enough water for their daily use. According to the saying of the local villagers who have lived in this area before industrial zone and the members of Community Peace and Development Committee, after the establishment of the industrial zone, urbanization has been taken place and there is over population, causing the depletion of one of the lakes for drinking water.

Urbanization also causes the degrading of water quality for consumption. However, not only pipe-line water cannot be sufficiently supported to the required water for the whole area but also the villagers are to buy with money. Because of the government does not supply the pipe-line water to the villagers directly. The government directly supplies the water to the factories which has been officially allowed to use and the villagers have to pay fees through these factories. So, low-income people can only rely on the pipe-line water for their drinking and they use the tube-well water for their other uses.

Besides, the villagers also suffer from water pollution because of the factories in the Hlaing Thar Yar Industrial Zone dispose the waste water, chemical and other byproducts into the small creeks and the Pan Hlaing River. There are about (170) various kinds of factories around the Thaunggyi Lay Village Group and they are around this village track. Some of the factories such as chemical factory, dying factory,

detergent powder factory, cold storage factory and so on are disposing their wastewater unsystematically through the ditches around them into the Pan Hlaing River.

Especially, one of the dyeing factories in this area disposes hot wastewater volume of (10000) gallons daily. This wastewater includes color, acid and chemical according to the testing of Yangon City Development Committee. Some villagers who live near this dyeing factory have to walk in this water and they suffer from the skin problems. Although there are ditches with the depth of (12) feet for releasing the wastewater from various industries, the wastewater can't flow easily due to the bad drainage system. Then sedimentation up to (11) feet occurred which makes the flow worse.

Another problem is the depletion of Pan Hlaing River since 2010. Because of these two problems, the wastewater can't flow quickly into the Pan Hlaing River. In this village track, water pollution has been growing after 2008 caused by the rapid population growth and industrialization. Before 2008, there were (10) tube wells in this village group, (5) tube wells can be used for drinking water. But after 2008, the more factories were established, the more the volume of water disposed by various industries. These effects of waste water disposed increased from industries can impact the tube-well water in this area indirectly because the color, taste and smell are gradually getting worse and worse compared to the situation in 1997. In the wet season, the color and smell of water significantly changes and it is not suitable for their daily use. So, the villagers suffer from the infection of cholera, diarrhea, typhoid, skin problems and others infectious diseases caused by impurity of water and disposed wastewater.

They have to incur the health costs that are caused by coming into contact with contaminated water if they do not get the clean water in the long run. This study can be used by policy makers and government organizations, non-government organizations and international non-government organizations involved in reducing these problems in the areas of wastewater is disposed systematically, education the ways of using water to protect the health problems and protection the environmental problems caused by industrialization as minimum as possible in the future.

Until quite recently, the pollution of natural water was not much of a problem, but with rapid urbanization and industrialization, this problem is reaching alarming proportions. In this area, industries discharge their untreated or only partially treated sewage and industrial wastewater into neighboring ditches. In doing so, they create intense pollution in ditches and rivers and expose the people who live in surrounding

area to dangerously unhygienic conditions especially in the rainy season, this wastewater cannot flow rapidly and flood in through the streets.

CHAPTER IV
SURVEY ANALYSIS

4.1 Survey Design

In this study, there are 313 respondents from Yae Oak Kan village and 204 respondents from Ward 20 in Hlaing Thar Yar. These villages are typical of urban villages in Yangon that they are densely populated. Most of people are poor and work in casual. They cannot get enough clean water for their daily use, the garbage system is poor, the surrounding environment is unhealthy conditions such as muddy, dirty houses. Then, the living standard is low and they have suffered from the infection diseases caused by wastewater of the industries near the villages.

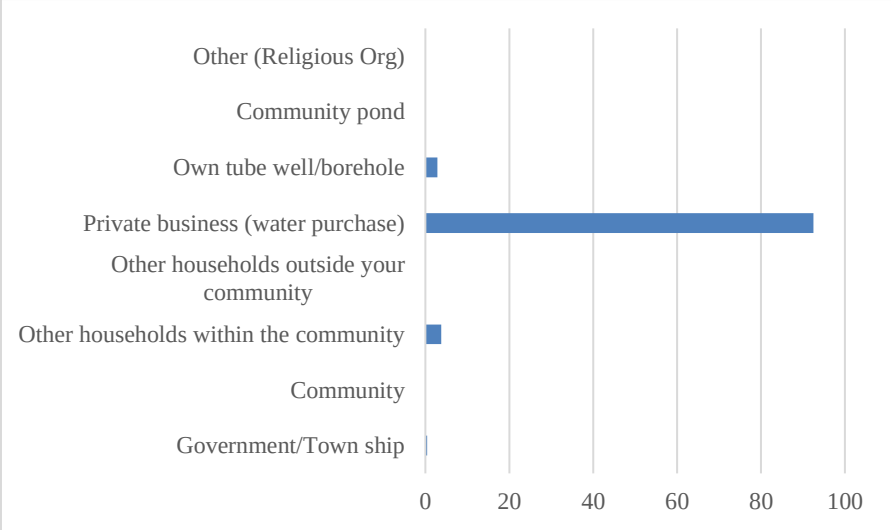
4.2 Survey Findings

In this survey, 396 households were interviewed. At (74.15 %), slightly more women participated in the survey than men. But these women could explain the situation of the water what they have been using daily and answered the questions clearly. Most respondents come from low- or middle-income households. They lived, on average, 30 minutes away from the industry. Their houses were mostly apartments and narrow spurious. One third of the respondents were migrants from outside of this area but most of them had been living in this area so long.

4.2.1 Access to water in Hlaing Tha Ya

In Hlaing Tha Ya, the households are using the drinking from private business by purchasing and they can get few percentage amount water from other household within the community and own shallow tube well / deep tube well.

Fig 4.1: Sources of Drinking Water to Household



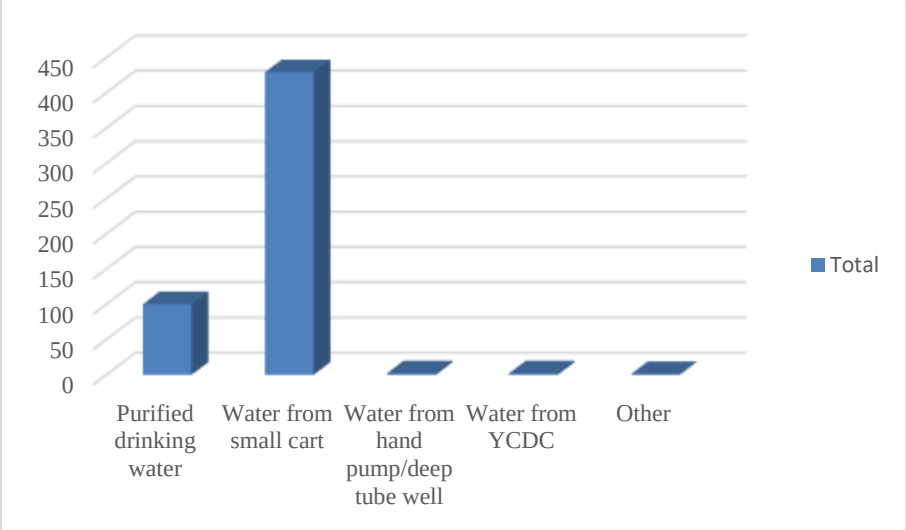
Source: Survey,2023

The main source of drinking water for households in the survey sample by township of residence. In the overall sample, only 6.3 percent of households reported piped water, either inside house or outside, as the main source of drinking water. The 26.5 percent of households reported that they are dependent on rainwater collection to meet their drinking water needs. 47.2 percent of households reported relying on bottled water for drinking water- this was the most predominant source (67.9 percent) in Hlaing Thar Ya. The (57.1 percent) of Households are depending on water trucks.

4.2.2 Sources of Drinking Resources in the Study Area

The people can get the drinking water from the small cart, hand pump, deep tube well, purified drinking water, water from YCDC.

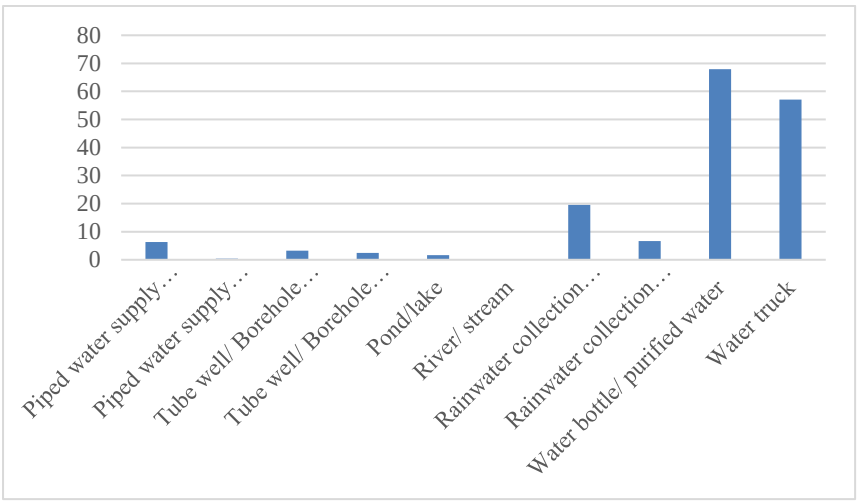
Fig 4.2: Drinking Water Resources in the Study Area



Source: Survey,2023

According to the data, most of the household, about 78% of the households, in the study are used the drinking water from small cart in the village. It is shown that they are enough for drinking water during water distribution from the existing water resources and 22% of households are required for clean and safe drinking water.

Fig 4.3: Percentage of Household Drinking Water Sources



Source: Survey,2023

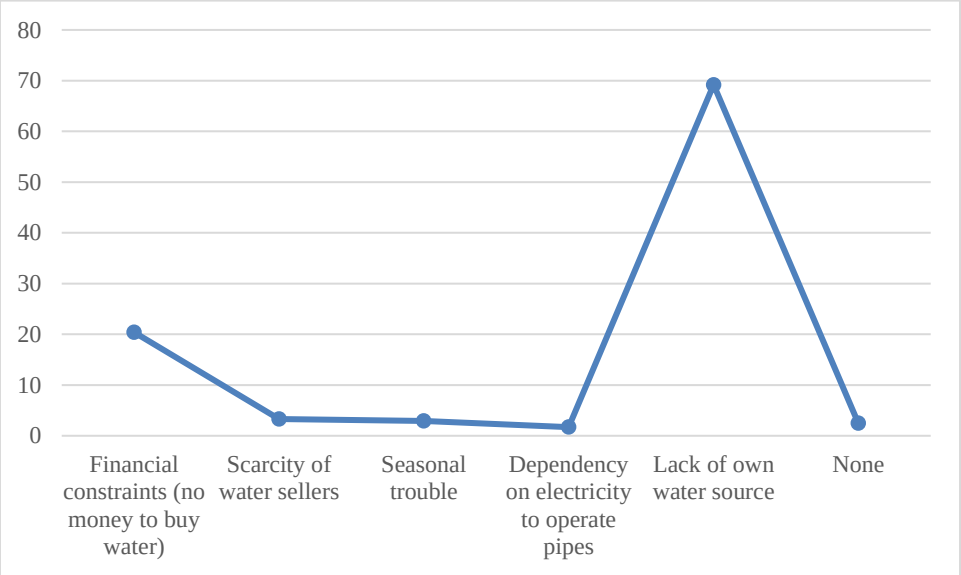
The most frequently cited difficulty in accessing drinking water was the lack of an own source for water, reported by 66.0 percent of households in the sample. Close to 25.0 percent of households reported financial constraints as the major difficulty in accessing drinking water.

4.2.3 Challenges to Access to Drinking Water in the Study Area

In the Study are, there are some challenges to access to drinking water especially in the hot season. According to the survey data, the difficulties to get sufficient the clean drinking water are as follow:

a) Financial constraints
b) Scarcity of water sellers
c) Seasonal trouble
d) Dependency on electricity to operate pipes
e) Lack of water source

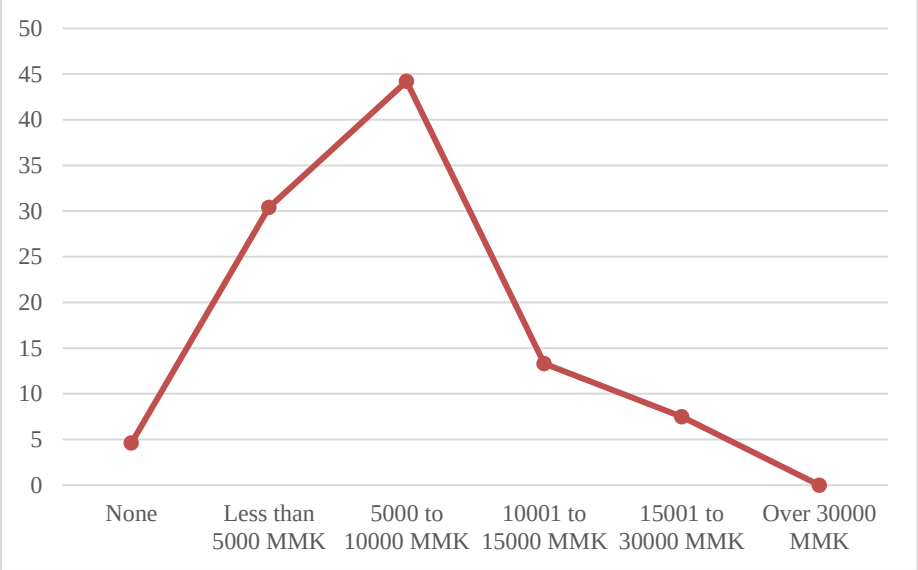
Fig 4.4: Percentage of Challenge to Access to Drinking Water



Source: Survey,2023

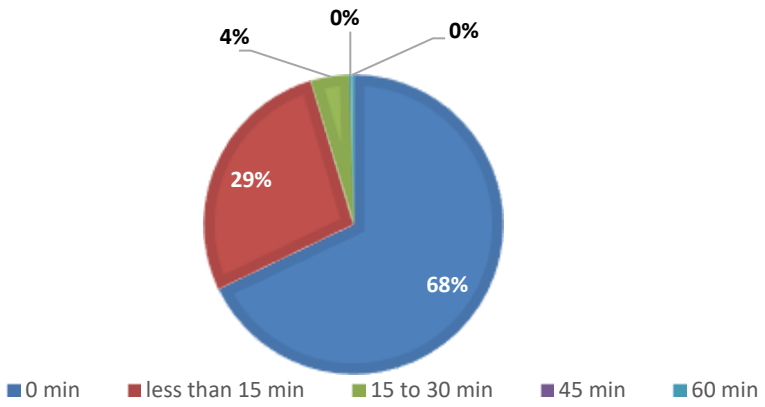
The households are using the monthly expenditure to access drinking water in which 44.2 percent of households spent between MMK 5,000 to 10,000 per month on drinking water while 30.4 percent spent less than MMK 5,000. 13.3 percent of households spent in excess of MMK 10,000 per month on drinking water.

Fig 4.5: Percentage of Money spent on drinking water per month



Source: Survey,2023

Figure 4.6: Percentage of Time Duration (Minute) to reach the drinking water source



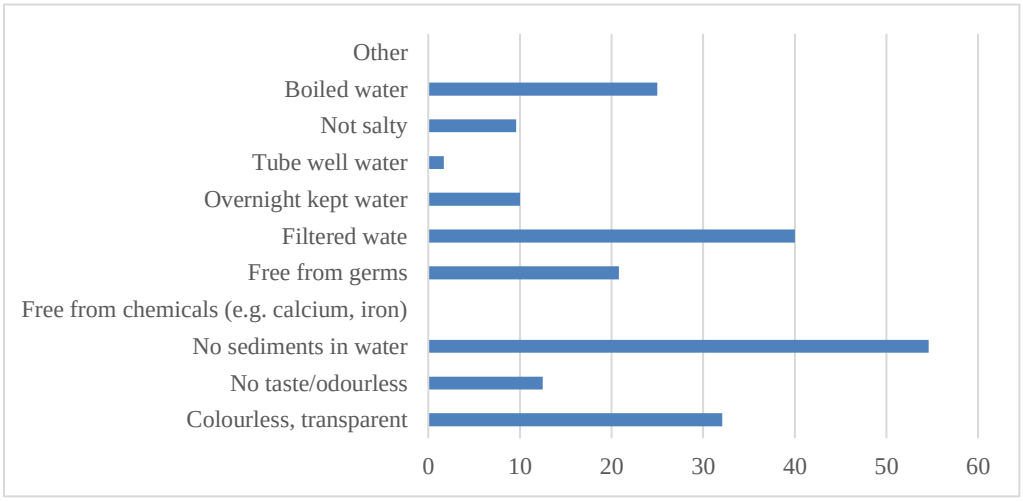
Source: Survey,2023

The majority of households in the sample 67.9 percent that drinking water was instantly available to them, without any waiting time. The 27.5 percent of households less than 15 minutes for accessing drinking water and 4.2 percent of households can access within 15 to 30 minutes as the time taken to access drinking water, 0.4 percent of household are more than 60 minutes' time to access drinking water.

4.2.4 Awareness the Water Pollution in the Study Area

Most of the household in the study are notice about the water pollution. According to the data, most of the respondents are not only low educated person but also, they have a little knowledge about water pollution.

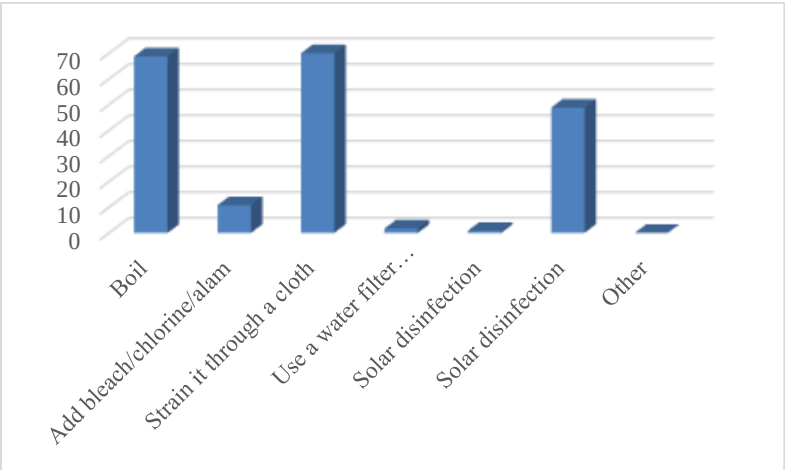
Figure 4.7: Percentage of respondents about the clean and safe drinking water



Source: Survey,2023

The number of households using boiled water and not using boiled water. In this survey, two-third of the households know very well to use boiling water for the health of their family but most of them are not used to boiling water.

Fig 4.8: Percentage about Knowledge of water treatment



Source: Survey,2023

4.2.4 Overall Findings in the Study Area

The number of households which is using the four types of water: (a) from Purified Drinking Water Factory, (b) Lake, (c) Shallow Tube-well, (d) Deep Tube-well

in this villages group for drinking, cooking and washing purposes. Majority of the households use more than one type of water daily.

The households usually use two types of water jointly together for their drinking, cooking and washing. Some households use Joe-phyu water for drinking as well as for cooking. Some households use Joe-phyu water and Deep Tube-well water for cooking. Some households use not only purified water but also Deep Tube-well water for their drinking. In accord with our survey results, drinking water is the most form of Joe-phyu water. As their cooking they use mostly Joe-phyu water and Deep Tube-well water. Shallow Tube-well and Deep Tube-well are used the most for washing.

If the vulnerable households cannot buy the purified drinking water, they buy the water jerry can (5-Gals Capacity) per 200 MMK as they said Gyo Phyu Water (they assume purified water) for drinking and cooking purpose.

Regarding for washing purpose in kitchen and cleaning toilet, some house has shallow tube well and use this water for this purpose. But, most of them have no space and did not have shallow tube wells. Therefore, they carry the water from near pond by themselves which is no need to pay charges.

If they will get the assistance the drinking water by donors and then they also buy the portable water (as they say Gyo Phyu Water) for cooking and domestic water from vendor for bathing and washing purpose. Also same as before distribution, household use the portable water from hand pump of shallow tube wells and surface water from pond.

Most of the house have the shallow tube well and they are using the water for washing clothes, cleaning and bathing purpose which the quality is also mostly over 2,000 ppm of TDS. Both Yae Oak Kan and Ward 20 locations, small commercial water treatment plants are selling the water as 60 MMK for one jerry can. They can buy at their plant and small cart vendors buy and then send to the residents with added the transportation charges.

According to the survey result from 534 Households, the number of 262 households want to get the water treatment system 49% of all households in Yae Oak Kan and Ward 20 for sustainable drinking water system. The 34% of 184 household want to proceed the drinking water distribution and the 4% of 19 households also want

to same but they are willingness to pay cost contribution. The 13% of 69 households who have the public space are want to provide drilling the community borehole.

CHAPTER V
CONCLUSION

5.1 Conclusion

The households in Myanmar in last five years toward improved water sources such as piped and bottled water, over unprotected water supplies such as surface water with its higher risks of contamination. The survey showed that 41% of households used safe drinking water countrywide which is behind global use 71% of the population.

In Myanmar, access to safe drinking water has been measured, at scale, and aligned with indicators used in the Sustainable Development Goals and Myanmar's Sustainable Development Plan. These results will allow for more clearly targeted support and investment by the government and development partners. Further information will be needed to provide a more nuanced and gendered understanding of the impact of household's use of different drinking water sources, including in urban and rural areas and by different population groups.

The wide diversity of drinking water sources will be needed to allow all of people access safer drinking water. Some areas remain especially vulnerable and need support to rapidly improve current drinking water options, most notably which are highly reliant on surface water. They have the lowest use of safe drinking water and are particularly exposed to the impacts of climate change. With long-term solutions beyond the financial reach of many communities, large and consistent blended financial support will be needed from Myanmar's government, development partners and financial institutions to fund and support cost-effective solutions.

The survey has collected important information on the safety of drinking water around the study area, however there are still many unknowns, including the presence of heavy metal contaminants in households' drinking water in some areas of the country.

The water distribution system in this area is very weak for the households. Most households have to use the impurity water and they have to spend some income for the water sources. Although the residents suffer from the several diseases, two-third of the respondents does not exactly know that it is caused by water pollution. Because of they are uneducated and they team to use unclean water. As well as they have no enough knowledge that the diseases are related to the water pollution and water pollution can

be occurred by the industrial zone and poor sanitation infrastructure especially bad garbage system, ill sewage system and poor drainage system.

5.2 Recommendation

According to this study, industrial zone is very close to this village group as well as the wastewater and byproducts released from the factories are not be disposed systematically. This fact can be harmful not only the health of the villagers but also the groundwater and environment. Nevertheless, we found that the households which use the water sources near the industrial zone suffer more diseases them the households away from the industrial zone.

This paper deliver as a message to reduce the impacts of impurity water and wastewater disposing from the industries and then should advocate the industries to reduce the waste with too low concentration for contaminated chemical as much as they can.

These findings will help the authority to understand the existing problems and to implement the necessary policies and guidelines.

Some of the area in Hlaing Tha Ya, the ground water of the deep tube well can make the water treatment system. So, the community need to provide the initial investment for communal water treatment unit for long term sustainable. By providing water treatment plant as the revolving fund which is the best solution for community to get purified drinking water and also get the job opportunity for instead of water distribution in water shortage period in every year.

Appendix: Questionnaire for Utilization of Water

Questionnaire Number: _____

Utilization of Drinking Water in Hlaing Thar Ya Township, Yangon Region

Myanmar

By

Kaung Myat Zaw

Information of Respondent:

Name of Respondent:

_____

_____

Village Tract / Ward:

_____

_____

Village / Sub Ward:

_____

_____

Date of interview:

_____

_____

Name of interview:

_____

_____

Remarks:

_____

_____

_____

_____

_____

_____

_____

_____

Master of Public Administration Programme

Department of Applied Economics

Yangon University of Economics

March, 2021

A. General Information

I. Respondent's Ideographic Data

1. Resident Status ☐ Permanent Resident ☐ Dormitory ☐ Squatter
2. Age: _____
3. Sex: _____Male _____Female
4. Name of Household Leader_____
5. Number of Children under 5 years_____
6. Total Number of Family Member_____

7. Marital Status_____

☐ Married ☐ Single ☐ Window ☐ Separated ☐

Others (Specify)_____

8. Education Level: _____

☐ Just Literate ☐ Primary ☐ Secondary ☐ High ☐

Others (Specify)_____

9. Occupation

☐ Casual Labor ☐ Factory Labor ☐ Private ☐

Government Staff

B. What is the main source of household for drinking water?

1	Piped water supply in/around the household	
2	Piped water supply outside the household	
3	Tube well/ Borehole in/around the household	
4	Tube well/ Borehole outside the household compound	
5	Pond/lake	
6	River/ stream	
7	Rainwater collection in/around the household	
8	Rainwater collection outside the household compound	
9	Water bottle/ purified water	
10	Water truck	

C. What water sources provide for drinking water?

1	Government/Township	
2	Community	
3	Other households within the community	
4	Other households outside your community	
5	Private business (water purchase)	
6	Own tube well/borehole	
7	Community pond	
8	Other (Religious Org)	

D. Do your household has functioning shallow tube well?

1	Damage	
2	Not Function (Replace Washer)	
3	Low Yield	
4	Functional	

E. How much time duration (minute) to reach the drinking source of water?

(Maximum 30 Minutes to reach drinking source according to Sphere Standard)

1	0 min	
2	less than 15 min	
3	15 to 30 min	
4	45 min	
5	60 min	

F. How many distance between household and water source?

(Maximum 500 meters to reach drinking source according to Sphere Standard)

1	0 m	
2	50 m	
3	100 m	
4	250 m	
5	500 m	

G. **How much cost consumption on drinking water per week**?

1	None	
2	Less than 1000 MMK	
3	1001 to 2000 MMK	
4	2001 to 5000 MMK	
5	5001 to 10000 MMK	

H. Do your house has roofing / container for water catchment for rain water?

1	CGI Roofing	
2	Plastic Sheet	
3	Tarpaulin	
4	That Kae	
5	Da Ni	

I. Do you have container for drinking water collection?

1	Ceramic Pot	
2	Jerry Can	
3	Plastic Bucket	
4	PVC Barrel	
5	Concrete Ring	

J. Do you know how to make the treatment the water?

1	Boil	
2	Add bleach/chlorine/alum	
3	Strain it through a cloth	
4	Use a water filter (ceramic, bio-sand, composite, etc.)	
5	Solar disinfection	
6	Let it stand settle	
7	Other	

K. Do you know about safe drinking water?

1	Colorless, transparent	
2	No taste/odorless	
3	No sediments in water	
4	Free from chemicals (e.g. calcium, iron)	
5	Free from germs	
6	Filtered water	
7	Overnight kept water	

8	Tube well water	
9	Not salty	
10	Boiled water	

L. What are the challenges to access for drinking water?

1	Financial constraints (no money to buy water)	
2	Scarcity of water sellers	
3	Seasonal trouble	
4	Dependency on electricity to operate pipes	
5	Lack of own water source	
6	None	

M. How many people are using the communal water hand pump?

(Maximum numbers of people per water source is 500 people per hand pump according to the Sphere Hand Book)

1	50	
2	51-100	
3	101-200	
4	201-300	
5	301-400	
6	401-500	

N. **How much queueing time to fill (5 Gallons) container of the communal water hand pump?**

(a flow of 17 Liters or 3.7 Gallons per minutes is sufficient water availability of indicator according to the Sphere Hand Book)

1	15 Sec	
2	30 Sec	

3	45 Sec	
4	60 Sec	
5	1 Minute 15 Sec	
6	1Minute and 30 Sec	

O. Do you know water related diseases?

1	Diarrhoea	
2	Dysentery	
3	Cholera	
4	Typhoid	
5	Hepatitis	
6	Polio	
7	Warm	
8	Do not know / No response	

P. Is there enough drinking water for the family?

(1) Not enough (2) Sufficient (3) Excess

Q. What are the suggestion to solve this problem for sustainable?

1	Water distribution	
2	Water distribution with cost distribution	
3	Drilling Community Bore Hole	
4	Communal Water Treatment System	
5	Others	

REFERENCES

Engineering Department (Water and Sanitation), YCDC, (2018). Water Quality Survey Report for Hlaing River Basin.

General Administration Department, Ministry of Home Affair, (2019). Township Profile of Hlaing Tha Ya.

Government of the Republic of the Union of Myanmar, (2016). National Investment Plan for Rural Water Supply, Sanitation and Hygiene (WASH), WASH in Schools and WASH in Health Facilities 2016-2030.

Mg Kyay Yay (U Myint Thein). (2018): Ground Water and The Series about Water.

MIMU, 2021. a MIMU Analytical Brief: *Changing Sources of Drinking Water in Myanmar (2014 - 2019).*

Ministry of Health and Sports, (2014). National Drinking Water Quality Standards Myanmar.

Ministry of Health and Sports, Ministry of Education, Ministry of Agriculture, Livestock and Irrigation (2016). The National Strategy for Rural Water Supply, Sanitation and Hygiene (WASH), in Schools and WASH in Health Facilities.

Ministry of Planning and Finance, (2018). Myanmar Sustainable Development Plan (2018 – 2030).

Ministry of Planning and Finance, (2022). Myanmar Statistical Guide: *Connecting the World with Data we can Trust.*

Ms. Lae Mon Thein, (2016). Health Impacts of Water Pollution in Yay Oakkan, Myanmar: Assessment of Health Impacts of Water Pollution in Hlaing Tharyar Industrial Zone.

National Water Resources Committee, Ministry of Transport, (2014). Myanmar National Water Policy.

The Sphere Project, (2011). The Sphere Hand Book: *Humanitarian Charter and Minimum Standards in Humanitarian Response.*

UN-HABITAT, (2019). YANGON INFORMAL SETTLEMENTS – RESETTLEMENT PROGRAMME (YIS-RP) Survey Report.

UN-HABITAT, (2020). MAPPING YANGON THE UNTAPPED COMMUNITIES: A preliminary study of informal settlements in Yangon.

UN-HABITAT, (2021). SURVEY REPORT: The impact of COVID-19 in informal settlements in Yangon.

WHO, (2014), Water safety plan: *a field guide to improving drinking-water safety in small communities.*